THE SANTA RITA EXPERIMENTAL RANGE: BETTER RANGE MANAGEMENT-WHEREVER IT IS PRACTICED-LEADS TO BETTER CATTLE AND LASTING ECONOMIC SECURITY

Matt J. Culley

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Better Range Management - Wherever It Is Practiced - Leads To Better Cattle And Lasting Economic Security

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The Santa Rita Experimental Range,[1/] established in 1903, is the oldest experimental range in the United States.[2/] It consists of 50,000 acres typical of the semidesert mixed grass and shrub range lands of the Southwest and lies along the western slopes of the Santa Rita Mountains about 35 miles south of Tucson, Arizona (fig. 1). The results of the research on the Santa Rita apply to some 20 million acres of range land in southern Arizona, southern New Mexico, and West Texas (fig. 2).

Topography, Climate, and Vegetation

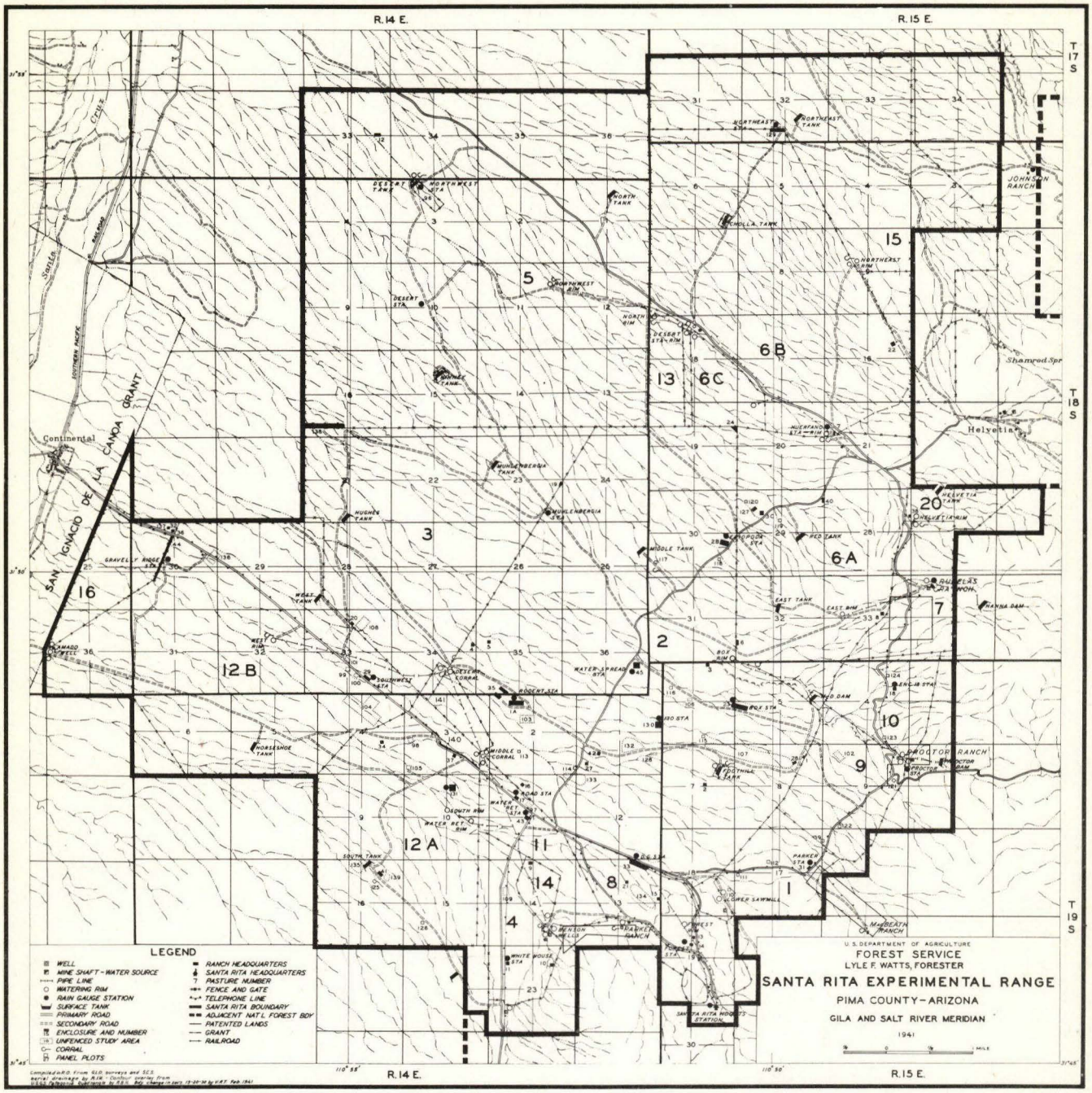
The Range slopes gently toward the northwest, varying in elevation from about 4500 feet near the mountains down to 2900 feet along the edge of the Santa Cruz river valley. It is cut by many shallow dry washes.

The climate is mild and dry. Temperatures vary from a low of around 20 degrees in the winter to a maximum of about 100 degrees in summer. Yearly rainfall varies from about 11 inches at the lower elevations to 18 inches at the upper with an average of about 14 inches over the entire range. Precipitation in different years may vary from 65 percent to 180 percent of this average. Rainfall during the summer growing season averages about 7½ inches or slightly over half the yearly amount, but this too is highly variable.

The forage is provided principally by a number of native grasses such as rothrock (Bouteloua rothrocki), slender grama (B. filiformis), sprucetop grama (B. chondrosioides), sideoats grama (B. curtipendula), black grama (B. eriopoda), hairy grama (B. hirsuta), Arizona cottontop (Trichachne californica), tanglehead (Heteropogon contortus), curly-mesquite (Hilaria belangeri), threeawns (Aristida spp.), and many others of lesser importance. The common browse species on the area are velvet mesquite (Prosopis velutina), falsemesquite (Calliandra eriophylla), range krameria (Krameria glandulosa), catclaw acacia (Acacia greggi), Wright eriogonum (Eriogonum wrightii), and baccharis (Baccharis spp.).

1/A branch field unit of the Southwestern Forest and Range Experiment Station, Tucson, Arizona.

2/At the time of its establishment, the Santa Rita Range Reserve, as it was first designated, was a unit of the Bureau of Plant Industry. In 1915 it was placed under the jurisdiction of the Forest Service and is now operated by the Forest Service in cooperation with the University of Arizona and three operating stockmen.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SAN IGNACIO DE LA CANOA GRANT
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PROCTOR RANCH
MADERATH RANCH
CANADA DEL ORO
SOUTHERN PACIFIC
LEGEND
WELL
MINE SHAFT - WATER SOURCE
PIPE LINE
WATERING RIM
RAIN GAUGE STATION
SURFACE TANK
PRIMARY ROAD
SECONDARY ROAD
ENCLOSURE AND NUMBER
UNFENCED STUDY AREA
CORRAL
PANEL PLOTS
RANCH HEADQUARTERS
SANTA RITA HEADQUARTERS
PASTURE NUMBER
FENCE AND GATE
TELEPHONE LINE
SANTA RITA BOUNDARY
ADJACENT NAT'L FOREST BDY
PATENTED LANDS
GRANT
RAILROAD
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FOREST SERVICE
LYLE F. WATTS, FORESTER
SANTA RITA EXPERIMENTAL RANGE
PIMA COUNTY - ARIZONA
GILA AND SALT RIVER MERIDIAN
1941
MILE
110° 55'
110° 50'
31° 55'
31° 45'

Figure 1.

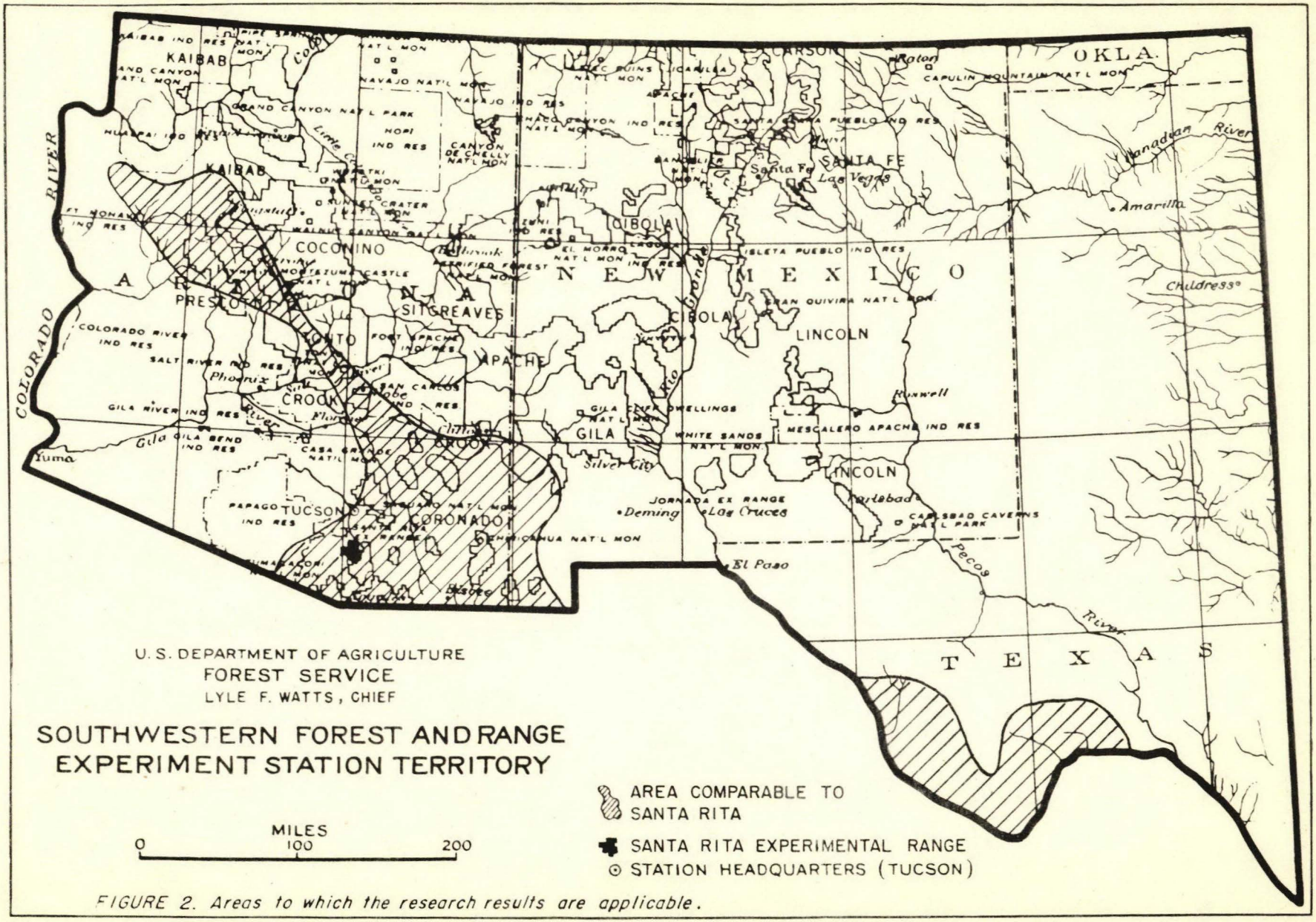


FIGURE 2. Areas to which the research results are applicable.

Although the entire experimental range is typical of the semidesert mixed grass range type, it consists of three major subtypes. The lower semidesert type varying in elevation from 2900 to 3500 feet is essentially a shrub type with a scattering of grasses occurring chiefly along the banks of the dry washes. Above this is the mesa type varying in elevation from 3500 to 4000 feet. This type supports a fair stand of the common native grasses with an overstory of the various shrub species. The foothill type above 4000 feet is essentially a grass type with a considerable quantity of shrub.

Development Prior to 1915

At the time of its establishment the forage cover of the Experimental Range was badly deteriorated as a result of heavy yearlong grazing over a period of years. It was immediately fenced and livestock were excluded from that time until 1915.

Early observations on the Range were made by the Bureau of Plant Industry toward two major objectives; (1) to determine the period of time that would be necessary for the range to regain its productivity, and (2) to determine the grazing capacity of such a range once it had reached a satisfactory condition. As to the first objective, it was felt that the range had returned to approximately normal condition by 1912, some 9 years after it had been fenced and cattle excluded. Information on the second objective was secured largely by clipping and by mowing hay and calculating the number of animals that the yields of forage should support.

FOREST SERVICE RESEARCH

In 1915 when the Range was placed under the jurisdiction of the Forest Service a range research program was begun with two major objectives. First of these was to determine the best ways to manage semidesert range lands, typical of the Santa Rita, in order to improve and maintain them at a sustained basis of productivity. The second objective dealt with methods of handling cattle on the range so as to secure the greatest annual returns over a period of time. It should be noted here that the Santa Rita Experimental Range is not merely a demonstration of good range management, but rather a range field laboratory where research into practices that appear to promise better results are conducted and evaluated.

The experimental management of the Santa Rita is unique. The land and improvements are owned by the Federal Government. The livestock grazing the range are owned and managed by three independent stockmen under a cooperative agreement with the Secretary of Agriculture. The stockmen run their herds yearlong on separate portions of the range according to a plan of management designed to provide proper grazing use, as well as to give an opportunity for tests and comparisons of various degrees and systems of use. The fact that the range is grazed by operating cattlemen makes the results obtained directly applicable to range practice.

Research in the management of the semidesert grassland type includes the determination of what constitutes the forage crop, the variations in yield of forage from year to year, relative importance of rain at different seasons of the year, maintenance of stand and forage yield, the degree of use that native forage plants can stand, the grazing capacity of the various range types, possibilities of improving depleted areas through natural revegetation, the grazing habits of range cattle, the effectiveness of salt as a means of controlling cattle distribution on the range, watering places necessary to secure the best use of the range, seasonal deferred grazing, and a plan of management to minimize or eliminate loss of livestock or damage to the range due to periodic prolonged drought.

Studies of handling cattle on the range include such phases as ways in which the annual calf crop might be increased, ways to improve the quality and quantity of beef produced, reduction of livestock losses, marketing practices, improved methods of handling range livestock, and the economics of range livestock production.

In addition to the study of the effects of experimental management on practical economic grazing units, the facilities at the Santa Rita provide for intensive studies of the climate, soils, growth of the vegetation and its use by cattle and rodents and the interrelation of these factors with one another. Cooperation is also maintained with several Federal and State agencies to facilitate studies in fields related to range research. Thus a balanced program of research that permits the development of fundamental knowledge as well as the application of these findings to ranchmen is made possible.

In recent years phases of two additional range problems have been added. One of these deals with working out methods for controlling various noxious plants and shrubs that have increased at an alarming rate on many semidesert ranges. The second deals with working out methods for reseeding ranges that have become so depleted that they will not revegetate naturally in a reasonable period.

Following is a resume of some of the findings obtained on the Santa Rita as they relate to the forage crop, use of the forage crop, costs and returns of range livestock production, modern ranching methods, good range management practices, noxious plant control, and range reseeding.

The Forage Crop

Grass makes the forage

The forage crop produced each year by the native range vegetation is of prime interest to range cattlemen. What it consists of, when it is produced, how it varies from year to year and what practices can be followed to assure a sustained supply are things that the modern stockman must know. Results on the Santa Rita have shown that the major part of each year's forage crop consists of the perennial grasses native to the region. Various browse species help to supplement the supply in the

fall and late spring and may be of extreme value in the severe drought years. As a general rule, annual weeds and grasses on the mixed grass type of range furnish but a small part of the year's forage supply, in fact, they cannot be counted on in more than about once in every 5 or 6 years.

Grass grows in summer

Studies have shown that 93 percent of the perennial grass growth comes during the summer period from June to September. Rainfall during this period varies greatly in amount, distribution, and the total period over which it occurs (fig. 3). The average length of the summer growing season is about 5½ weeks with extremes as low as 2½ weeks and in one instance as much as 11 weeks of active growing weather. In the majority of years growth may start and stop several times during the summer. For this reason the rancher should judge his forage crop by actual inspection of the range at the close of the summer rainy season rather than from the amount of rain that falls during the summer months.

The extreme variation that may occur in the annual yield of grass is well illustrated by the production of 130 pounds of forage per acre in 1925 as compared to a yield of 700 pounds in 1931 (fig. 4). Such differences must of necessity be reflected in the number of livestock that can be carried from year to year. Stocking on the basis of each year's production would necessitate a considerable variation in numbers to fit the amount of forage available, a basis of operation that would be difficult for the cowman to practice. Stocking with a more or less uniform number of cattle on the basis of the average yield of forage would result in a shortage of forage in 4 out of 9 years.

Conservative stocking is safest

Results on the Santa Rita indicate that stocking at a rate about 20 percent below that indicated by the average yield of forage is a safe basis of operation. This would satisfactorily provide for all but 2 years of the 9. In such years some feeding may be necessary, but often the unused forage from previous years will be sufficient to carry the livestock without supplemental feed. Longtime records on the numbers of cattle that have grazed the various pastures and types of range suggest that a safe basis for stocking in the semidesert subtype is about 7 to 8 head per section, in the mesa type about 12 to 14 head per section, and in the foothill or better grass type about 18 to 20 head per section. These stocking rates are for periods of average production including occasional drought years. In times of extended drought they should be reduced accordingly. Since the bulk of the forage is grown before marketing time in the fall, the stockman can adjust his sales each year in order that his stocking rate will be in line with the forage available.

Use of the Forage Crop

Cattle need ample forage all year

Leaving a part of the herbage produced on the ground each year allows the range a chance to improve in the better years and more or less

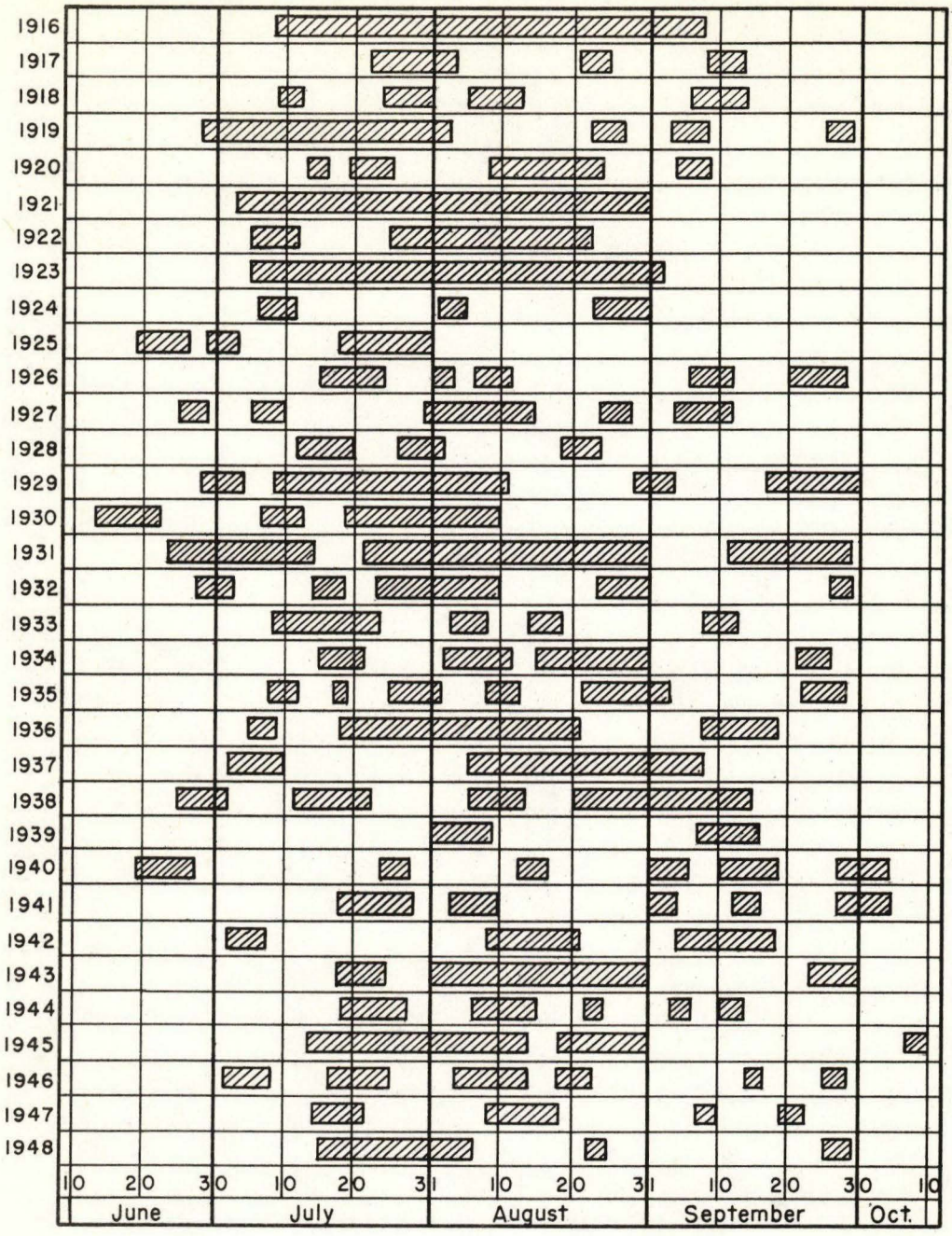


Figure 3.--Variability of effective rainfall and active forage growth periods during the summer growing seasons from 1916 to 1948 on the Santa Rita. Note the short periods of effective rainfall and growth in 1924 which resulted in very low yield of forage as compared to high yield in 1931 when rainfall and growth were more or less continuous throughout the summer. Effective distribution rather than the amount of rainfall is what counts in the production of a forage crop.

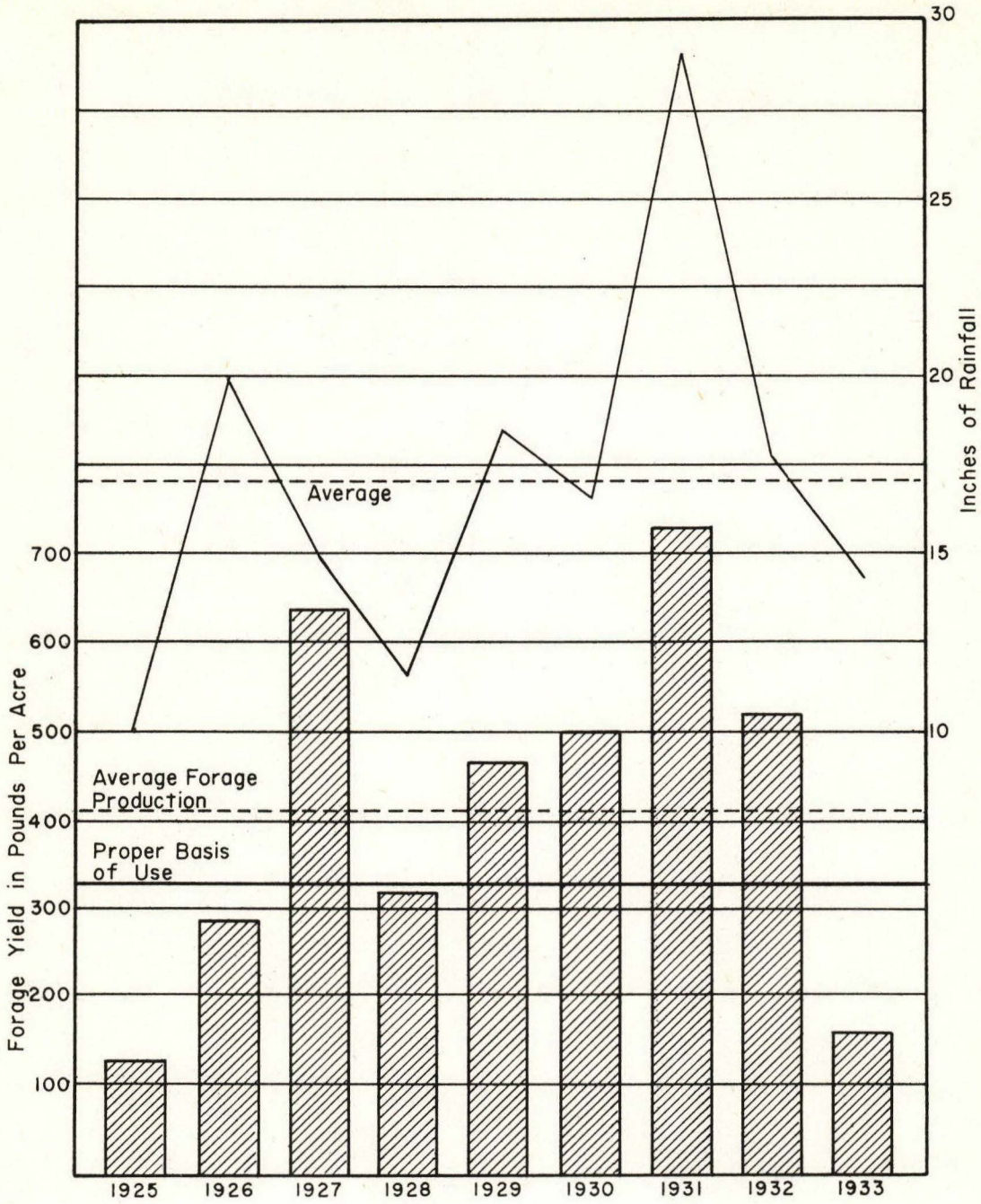


Figure 4.--As is the case everywhere, the yield of forage on the Santa Rita varies greatly from year to year. Stocking on the basis of the average yield would result in a rather serious forage deficiency in four out of the nine years. The proper basis of use for the semidesert mixed grass ranges is approximately 20 percent below the average capacity and brings numbers of stock into balance with the yield of forage in all but two years. Some supplemental feeding in these severe drought years may be necessary, though under good range management the carry-over of feed from the better years will generally offset the need even for this.

hold its own in poor years. During periods of severe drought, which are normally to be expected at regular intervals, forage production may drop to as little as 1/3 of the long time average. There is no sound way out other than to reduce the numbers of livestock accordingly or start feeding supplements early enough so that the cattle do not start to lose flesh. Some additional measure of insurance may be provided by reserving small pastures against such critical periods. Such forage need not be lost in the good years since it can be utilized for extra conditioning of animals. Too often, however, the operator, rather than cutting his herd down to the forage supply, takes a chance and holds over his salable livestock. He thereby loses, not only by severely overgrazing his range but also by adversely affecting the quality and size of his animals. One principle to remember is that although good cattle may survive for a time on short rations they require ample forage year in and year out if they are to make full growth and development.

Leave some grass ungrazed

Studies of the degree of grazing the various native grasses can stand without injury have indicated that in general most of the native grama grasses should not be used closer than to within about 2 inches of the ground. Black grama which is often an important species on semidesert grass ranges should not be grazed closer than 3 inches from the ground. The coarser or bunchgrass type of grass appears to suffer if grazed continually to heights of less than 4 or 5 inches. A few species such as the common hoe grass (Muhlenbergia porteri) do not appear able to stand use closer than to within about 6 or 8 inches of the ground. It was found that cattle naturally tend to graze conservatively when the supply of forage is adequate. Only when cattle are forced to go back over an area day after day do they utilize the perennial grasses too closely.

Observations on seasonal or deferred rotation grazing suggest that lightening up grazing on the range during the summer growing season or allowing portions to rest during this period every second or third year results in a greater variety of the better forage grasses as well as greater forage production.

Calves are the cash crop

Throughout most of the southwestern semidesert range country calves are the chief product marketed. Consequently, one of the first objectives is to secure as many calves as possible each year (fig. 5a).

Under conditions on the Santa Rita, it requires a calf crop of about 55 percent to pay the operating expenses. The average of 85 percent that has been realized on the Santa Rita for the past 20 years leaves a substantial margin for profit. One of the most important factors in realizing this calf crop has been maintaining the breeding cows in good condition throughout the year by stocking moderately. Another factor that has helped is the division of the range into pastures carrying from 50 to 100 head of breeding cows. This permits much closer supervision and makes the culling of non-productive cows more certain. The use of good active bulls as well as the careful selection of cows for active breeding and good mothering qualities has also aided.

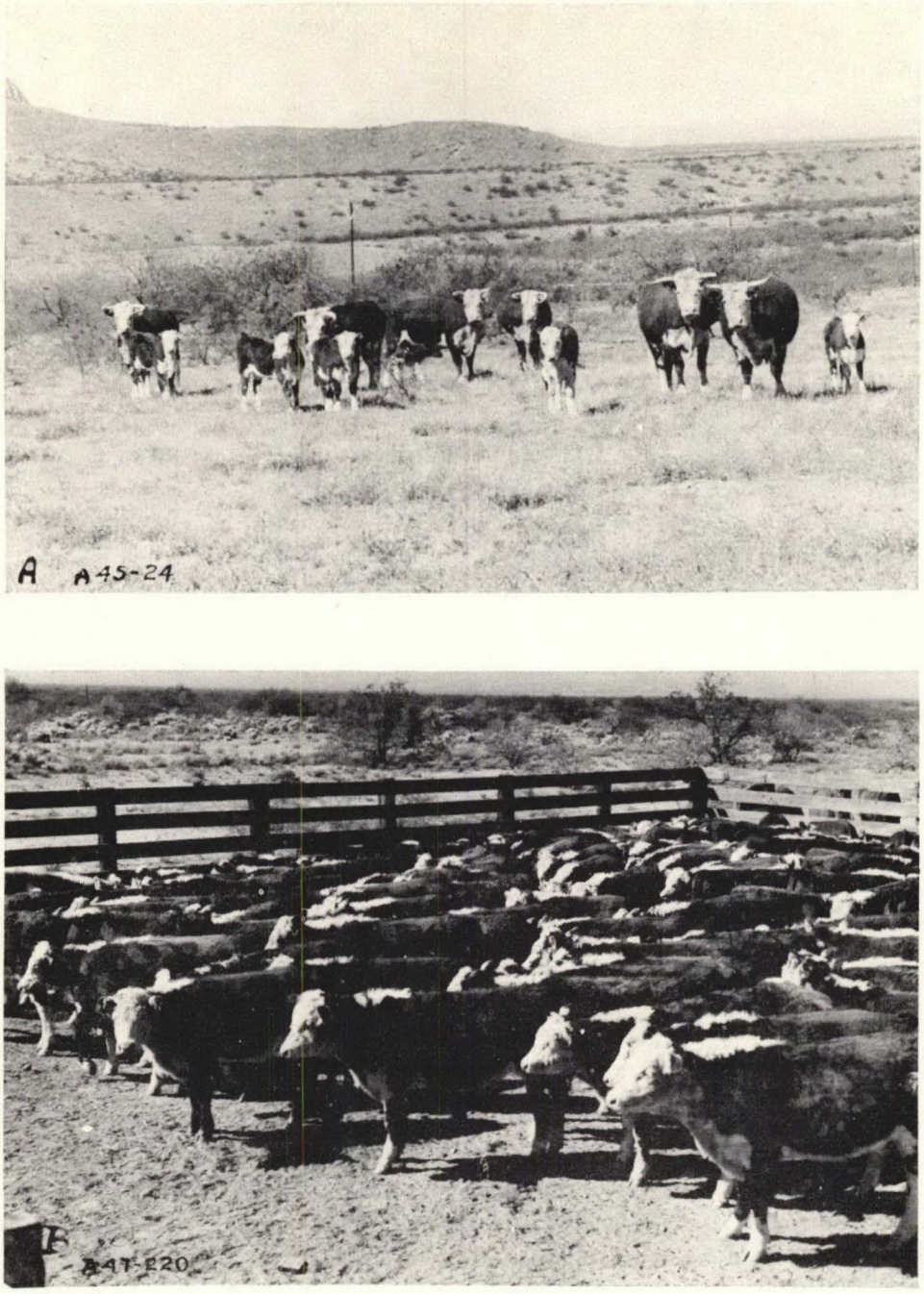


FIGURE 5.--GOOD CALF CROPS AND QUALITY CATTLE ARE ESSENTIAL FOR SUCCESS

A, It takes a 55 to 60 percent calf crop to pay the expense of operation. The average calf crop of 85 percent attained on the Santa Rita leaves a substantial margin of profit. B, Quality calves are produced only by rigid selection of breeding stock, culling off of undesirables, and plenty of range feed. These calves averaged 452 pounds at 8 months of age.

The size and uniformity of calves is also an important item governing the returns that can be expected (fig. 5b). A regulated breeding season has helped greatly in producing uniformity. Attention to the condition of the breeding cows during the late spring season has greatly increased the average size of calves produced. The calves on the Santa Rita now average well over 400 pounds each year and in one year averaged as high as 470 pounds at 8 months of age.

Continual efforts to improve the grade of cattle on the Santa Rita by using only the best quality bulls and by careful selection of replacement heifers and constant culling of breeding cows have resulted in increasing weights of breeding cows from approximately 850 pounds to well over 1,000 pounds. These larger, thriftier animals produce more and better calves and are better able to maintain production in dry years. Ample range forage at all times has played an important part in improving the quality and size of the animals in the breeding herd.

Death losses can be small

As a rule, livestock losses on the range are taken as a matter of course with a feeling that there is not much that can be done to reduce them. Results on the Santa Rita have indicated that careful supervision, keeping the breeding cows in condition to properly care for their calves, continual doctoring of sick animals along with the control of predators can do much to reduce the annual livestock losses on the range. Santa Rita losses average less than 1½ percent for all classes of livestock.

Costs and Returns

Holding down expenses

Cost keeping is essential so that an operator may know--not only what he is making--but also what he is spending. What profit he makes shows up in his bank account at the end of the year, but what he spends is gone and perhaps for things that he might very well have done without. Costs of operating a cattle ranch change with the times (fig. 6). In the period 1924-34 a large item of expense on the Santa Rita was interest paid on borrowed operating capital. Realization of this led to the operator paying off his debts so that in the second period of operation 1940-47 the money that was formerly paid out as interest came to him as a yearly return on his owned capital. Bull and cow replacement costs were relatively high during the first period since grade improvement was one of the major objectives at that time. This practice, however, has paid for itself many times. Feed costs were relatively low during the first period but increased markedly in the period 1940-47 due to severe drought conditions. Labor costs during the second period rose to almost three times what they had been in the first period and suggest that the operator analyze his labor needs and take advantage of labor saving devices or methods.

On the Santa Rita, during the period 1924-34, the total capital investment was broken down into livestock 65.2 percent, physical improvements 32.5 percent, and lands 2.3 percent. That livestock production can be profitable on semidesert grasslands under good management

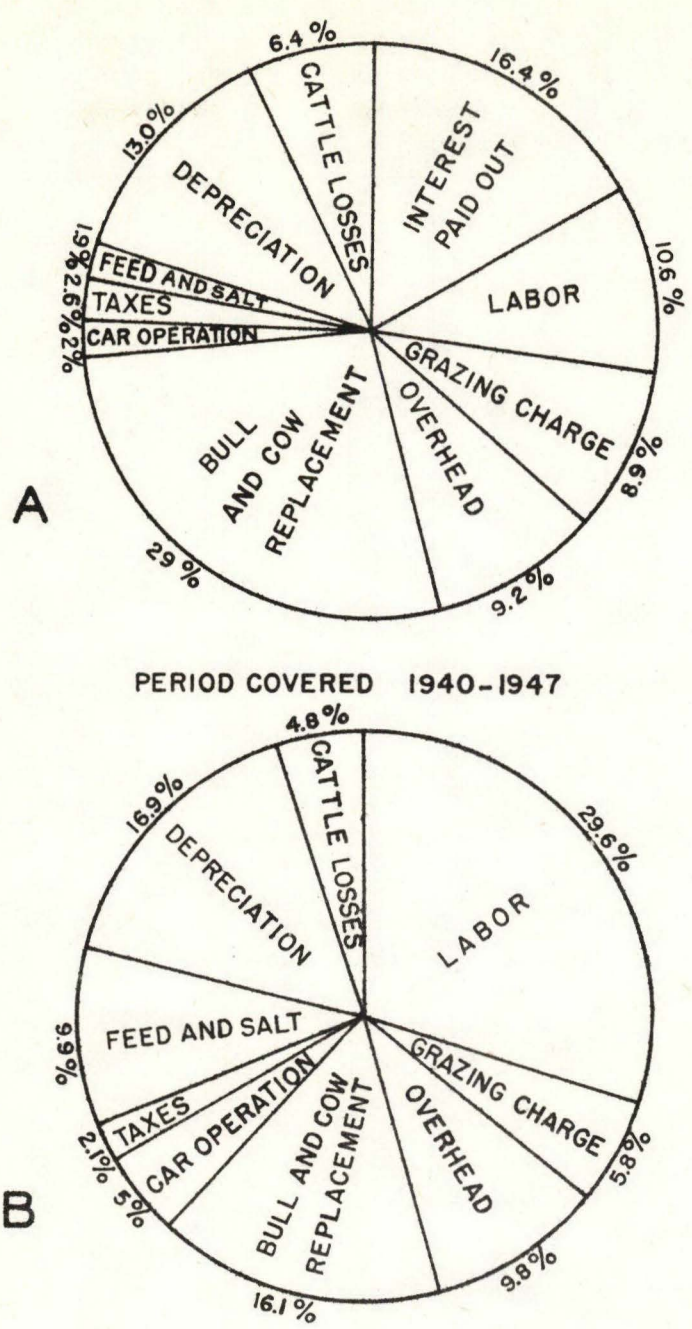


FIGURE 6.--COST RECORDS AND THEIR ANALYSIS HELP TO SHOW WHERE THE MONEY IS GOING.

A, During the period 1924 to 1934--on the Santa Rita--interest paid out on borrowed money was a substantial item of cost and represented a heavy drain on the returns. Bull and cow replacement costs were high under a program of herd betterment but in the end brought increased returns that fully justified their outlay. B, In the period 1940 to 1947 operating on borrowed capital had gone out of the picture. Money formerly paid out as interest now represents a return on owned capital. High labor costs on the other hand suggest that serious consideration now be given to labor saving devices in the handling of livestock.

is indicated by an average return to the operator for his labor and management of $8.13 for every $100 invested, plus 6 percent interest on his own money.

Modern Ranching Methods

Better than the "good old days"

Much can be said for the old ways of doing things on the range. They were romantic, fun, and led to a simpler and more friendly way of life. However, they cannot compete with the modern way of doing business. Cattle of earlier days were easily able to walk several miles to water. The higher grade, heavier cattle of today require that all parts of the range be within 1 to 1½ miles of water. The old open range methods have been replaced by fenced pastures in which comparatively small numbers of cattle are run, making for easy and constant supervision. Such added conveniences as holding traps, corrals, squeeze and separating chutes, calf branding tables, and horse trailers are all a part of the modern way of running the range cattle business (fig. 7). They not only help to cut down the labor costs and save time but are easier on the livestock, minimize injuries, and result in producing more pounds of beef. Trucking cattle to market eliminates shrinkage besides saving both labor and time. Ranchers would do well to analyze their ranch operations and employ these labor saving methods.

Noxious Plant Control

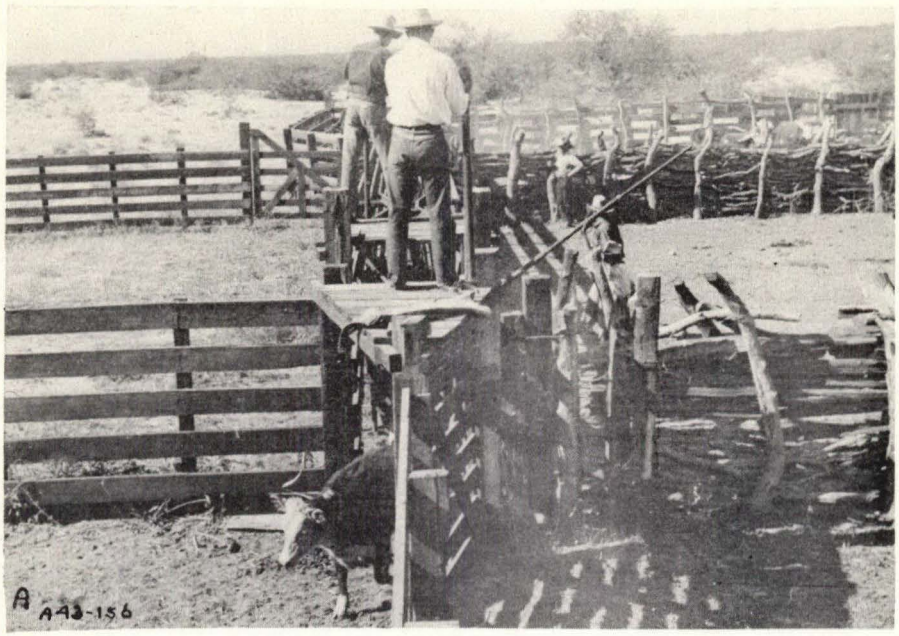
Insidious invaders

In recent years many noxious plants and shrubs, which replace valuable forage grasses and complicate handling of livestock, have increased or spread over southwestern ranges (figs. 8 and 9). Perhaps the most common of these are mesquite, cholla cacti (Opuntia spp.), juniper (Juniperus spp.), burroweed (Aplopappus fruticosus), and broom snakeweed (Gutierrezia sarothrae). With the exception of mesquite, most of these are valueless as forage. Even the grazing value of mesquite does not make up for the forage grasses that it displaces.

Control methods vary

No magic formula has yet been developed for eliminating unwanted range plants. The most effective method for killing mesquite is the application of diesel oil either to the base of standing trees or to the stumps that remain after the trees have been cut (fig. 10 b). The essential requirement is that the oil be spread entirely around the trunk and be made to penetrate downward along the root for 6 to 8 inches. In most instances, a pint of diesel oil per tree is sufficient. The most effective time for this treatment is during the dormant season beginning about the first of October and ending around the 31st of March.

Cabling—dragging a 300-foot loop of heavy cable or chain between two large tractors—promises to be effective and comparatively cheap method for reducing stands of mesquite or juniper. It is best done while the ground is wet so that the trees will pull up easily. Research to



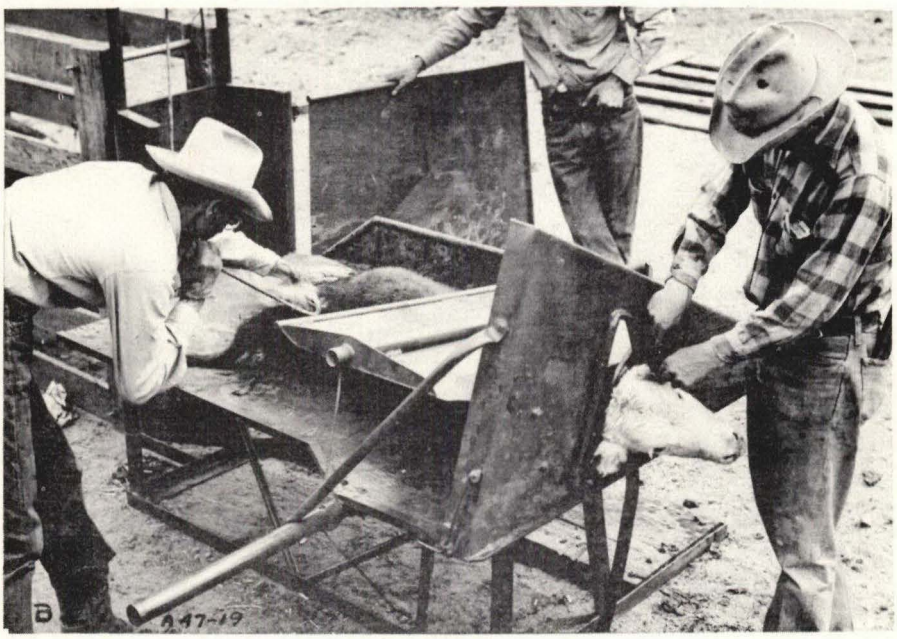


FIGURE 7.--MODERN HANDLING METHODS SAVE LABOR, TIME, AND STOCK

A, Separating chutes are not only faster but they save labor and are easier on the cattle-reducing shrinkage-and thus adding many pounds of beef to the total that is marketed each year. B, Calf branding chutes save labor, require less skilled help, prevent injuries, and are easier on the calves and cows than the old method of roping out of a herd.

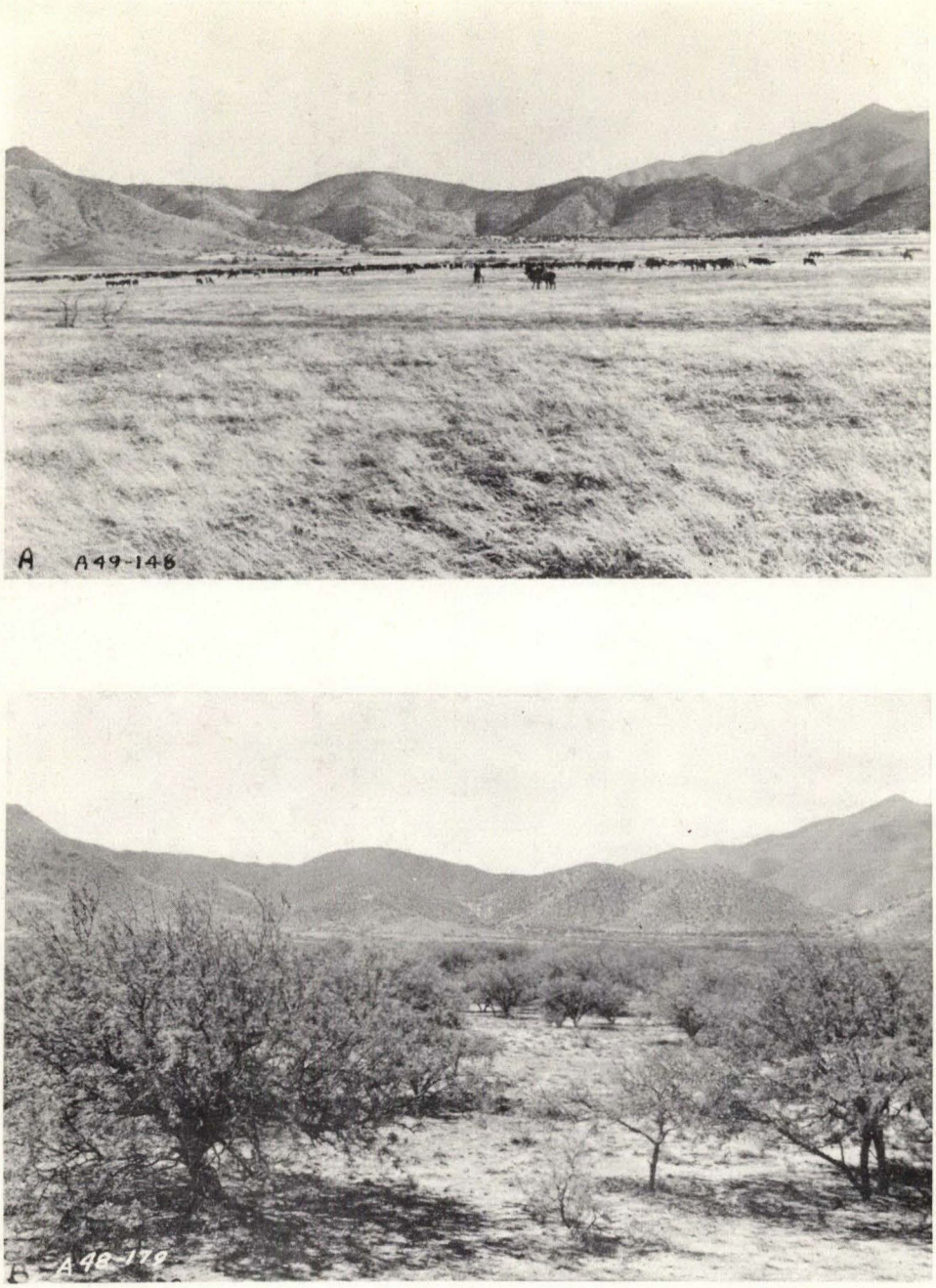


FIGURE 8.--MESQUITE AS WELL AS OTHER NOXIOUS SHRUBS A PROBLEM OF INCREASING IMPORTANCE ON MANY SOUTHWESTERN RANGES

A, A typical semidesert mixed grass range area in 1903, supporting forty to fifty head of cattle per section. Mesquite then was confined largely to the waterways. B, The same area in 1948. Mesquite has taken over - 200 to 250 mature trees per acre - and displaced the forage grasses with the result that the range now carries but 15 head per section and supplemental feeding is often necessary.

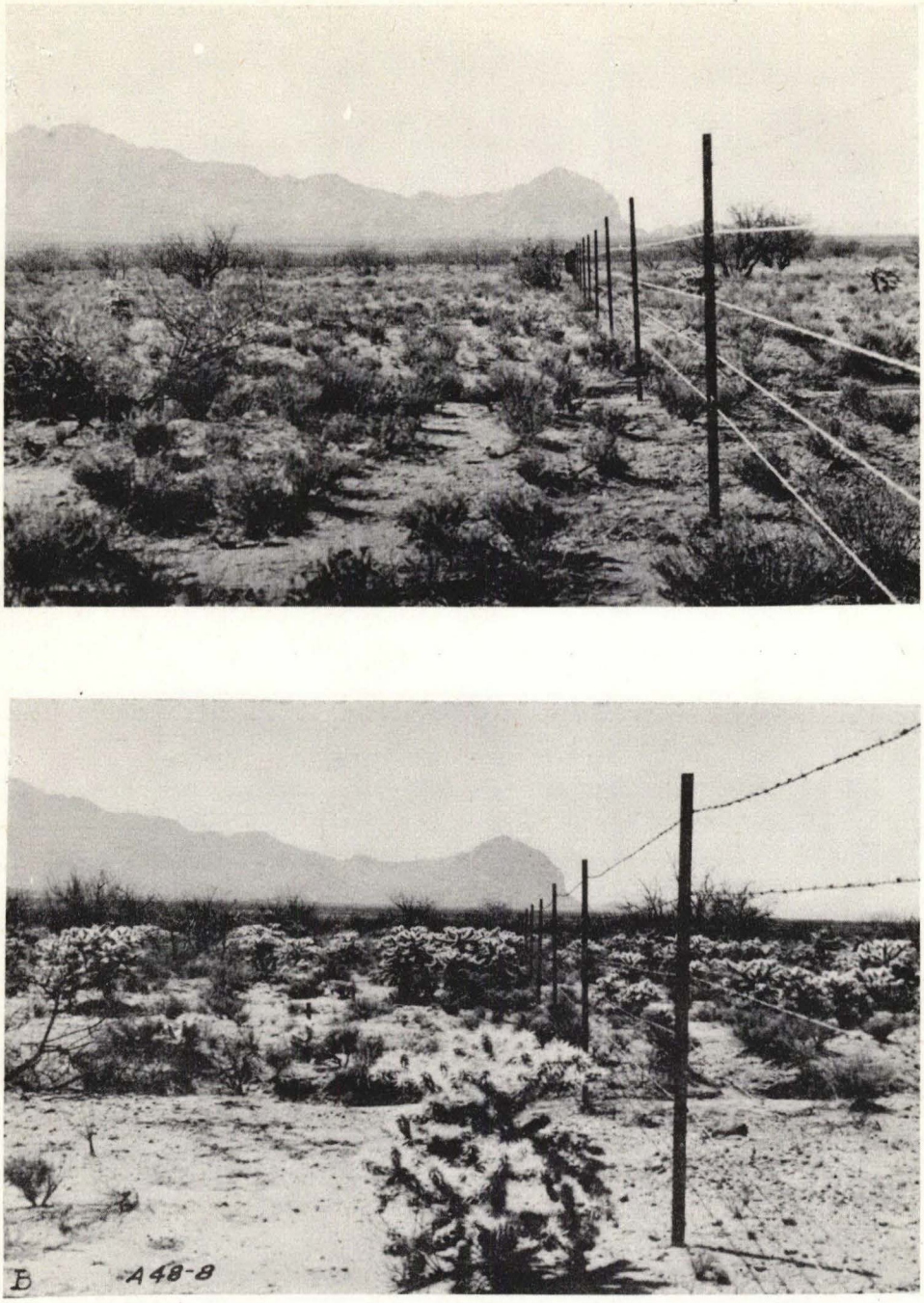


FIGURE 9.--CHOLLA CACTI ARE WELL ON THEIR WAY TO BECOMING A PAINFUL PROBLEM ON MANY SEMIDESERT RANGES

A, A typical range area with only scattered cholla cacti in 1934.
B, By 1948 the same area has been taken over by two to three hundred cacti per acre and the area is fast becoming inaccessible to both stock and man.

FIGURE 10.--RESEARCH IS DEVELOPING METHODS FOR THE CONTROL OF NOXIOUS PLANTS ON THE RANGE

A, Many chemical sprays are being tried out in the control of cacti. A small air compressor and 50 gallon supply drum can easily be mounted in the bed of a pickup. Pressures of 20 to 25 pounds are necessary for effectively spraying the entire plant. One or more hose equipped with extension spray tips can be connected to the supply barrel. B, Diesel oil - properly applied - has proven the most effective method for controlling mesquite on the Santa Rita. As shown above it can be applied to standing trees as well as stumps. The tree in the left background was killed with diesel oil. Proper application means seeing that the oil soaks into the ground for several inches entirely around the base of the trunk or stump.

devise more economical and effective methods for controlling noxious range plants is being continued. Fundamental knowledge of the way in which noxious range plants grow and reproduce is essential for sound control, and research is being directed to that end.

On grasslands invaded by a scattering stand of small mesquite or juniper, the rancher can make no better investment than hand grubbing to stem the invasion and preserve the productivity of the grasses.

In the case of cholla cacti, spraying the entire plant with hormone sprays (2,4-D and 2,4,5-T) in reasonably high concentrations (fig. 10a) shows the most promise to date although more work remains to be done before the method can be considered as entirely effective. Sodium arsenite has proven fairly effective in the killing of juniper but is too expensive to be practical under most conditions.

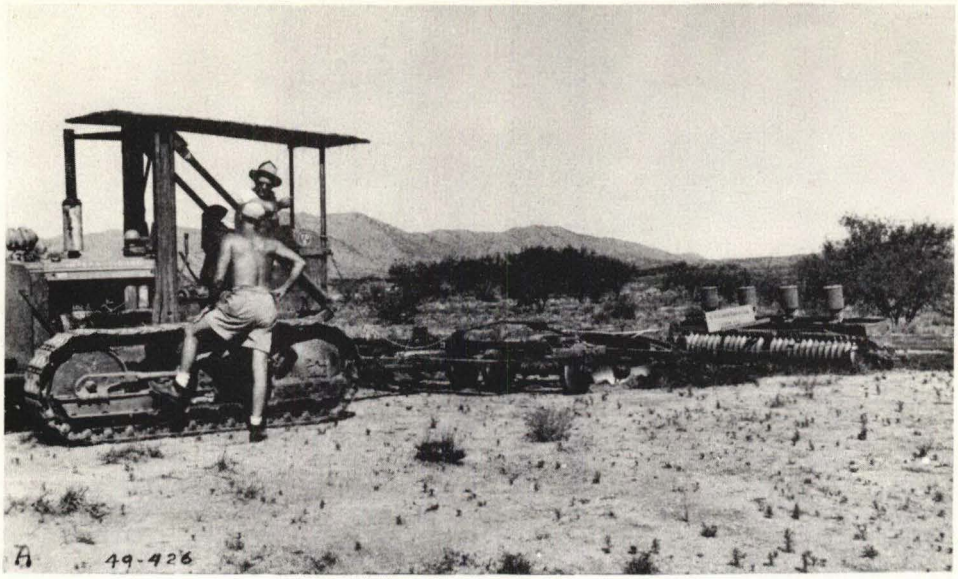
Range Reseeding

Some grasses appear promising

Drought, heavy grazing, and in many cases the rapid spread of noxious plants or a combination of all of these factors have resulted in depleting considerable areas of range land in the Southwest, thus creating a growing demand for reseeding such areas in order to hasten their return to full forage productivity. Research is centered on devising suitable methods of seeding and finding species of forage plants, either native or introduced, that are adapted to the scanty and highly undependable rainfall of semi-desert grasslands. In one of the four years since reseeding research was started on the Santa Rita, excellent stands of grasses were obtained. Summer drought conditions during the remaining years have seriously affected the establishment of seedlings. Species such as Lehmann lovegrass (Eragrostis lehmanniana), and Boer lovegrass (E. chloromelas), tanglehead, and Arizona cottontop have become established in places and show enough promise to justify further investigations as to means of getting them established. Other species that have shown promise under somewhat similar conditions elsewhere are sand dropseed (Sporobolus cryptandrus), Wilman's lovegrass (E. superba), blue panicum (Panicum antidotale), and slender grama.

Planting methods to hold the moisture

Reseeding equipment that appears most effective on reasonably accessible range areas is shown in figure 11a. This consists of a small caterpillar, a V-type eccentric disc, and a cultipacker seeder. This outfit can cover about 20 acres per day completely seeding an area or about 40 acres per day with about half of the ground seeded. The eccentric disc serves to make small depressions in the soil which tend to hold excess surface water and thus provide more favorable soil moisture for the young seedlings (fig. 11b). On many deteriorated semidesert grasslands, adapted species, seeded with suitable methods, can aid in bringing back a good forage cover (fig. 12).



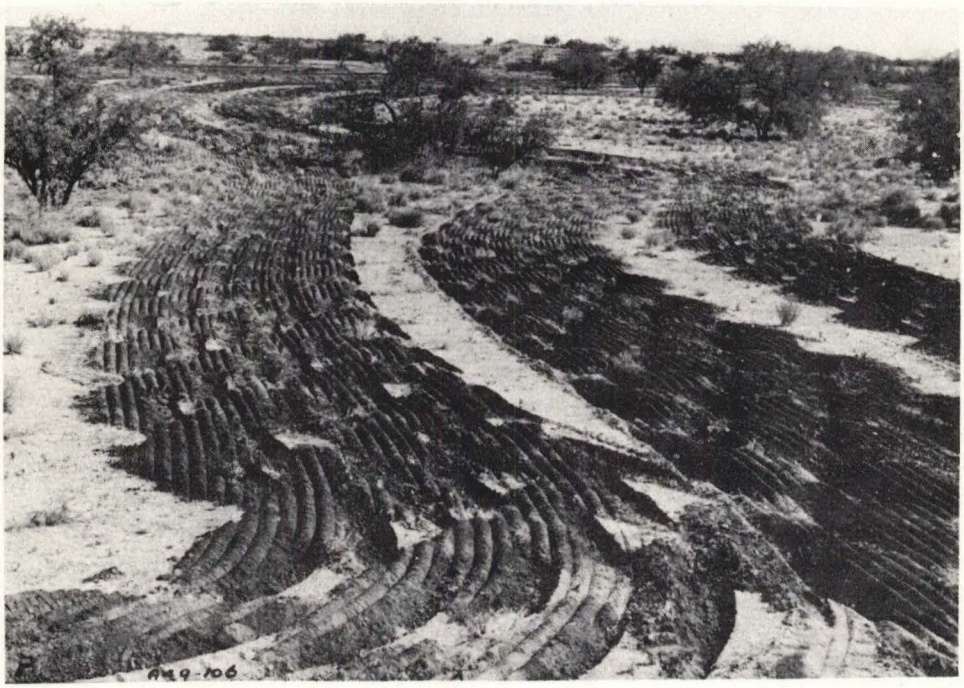


FIGURE 11.--IN MANY PLACES NATURE NEEDS HELP IN ORDER TO BRING THE RANGES BACK INTO PRODUCTIVITY

A, Reseeding equipment that can be effectively used in reseeding range areas. A small caterpillar, a V-type eccentric disc, and a cultipack seeder such as the outfit illustrated can cover many acres per day in reasonably accessible country. B, In this area that has been reseeded note the regularly spaced depressions made by the eccentric disc for the purpose of holding extra water from run-off during the summer rainy period.

FIGURE 12.--WITH A LITTLE HELP FROM MAN THE RANGE CAN BE BROUGHT BACK

A, A typical area in the semidesert mixed grass type in its natural condition. A heavy stand of mesquite and other shrubs have taken over the area and displaced the perennial grasses. B, The same area two years after the mesquite was cleared off and the area reseeded. Lovegrass, tanglehead, and other grasses are now well on their way to rehabilitating the area.

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SEVEN POINTS OF GOOD RANGE MANAGEMENT

Certain practices that will help obtain better range management can be recommended as the result of studies and observations on the Santa Rita Experimental Range. These are:

1. Division of range by fences into breeding herd units of from 50 to 100 head.--Such a practice makes possible (a) better control of cattle with more uniform use of range and less concentration, (b) the application of seasonally controlled grazing as a means of bettering range condition, (c) easier supervision and working of cattle, and (d) higher calf crops by 5 to 10 percent which in large measure help to cover the cost of dividing up the range.

2. Rotation deferred summer grazing.--Observations have indicated that under deferred and partially deferred summer use (a) the forage composition is improved; the better forage grasses are more abundant, (b) the annual yield of forage is higher, (c) the chance for improvement in stand and vigor of forage grasses--in good years following drought--is greatly increased, and (d) green forage is available later in the fall and earlier in the spring.

3. Adequate distribution of water.--Adequate water is one of the major problems on semidesert ranges. It can usually be developed, however, either with temporary surface tanks or with wells or springs together with pipe lines. Well distributed watering places aid materially in (a) keeping cattle distributed over the range, (b) preventing local overgrazing, and (c) keeping livestock in better condition. The number of cattle at each watering place should not exceed the grazing capacity of the available range within a 1½ to 2 mile radius.

4. A better understanding of the growth habits and requirements of range forage plants.--The growth of native vegetation too often is taken as a matter of course with little appreciation for the real struggle that semidesert forage plants have to maintain themselves on the range. Full realization of how and under what conditions valuable range plants grow best, their seeding habits, their response to grazing and how they can be helped in their efforts to keep alive and produce abundant herbage would help measurably to improve ranges generally.

5. Closer observation of range conditions--The average range user--living as he does on the range throughout the year--is sometimes at a loss in trying to evaluate the condition of his range. Usually the changes that occur are so slow that they are more than likely to pass unnoticed. In the absence of some definite measurements or records it is difficult even to compare forage growth of one year with that of another, much less to judge changes that may occur in composition or stand. In occasional instances--such as the past two years of severe drought--the changes became obvious enough to be easily seen, but by then damage is serious. Photographs taken on different parts of the range and repeated at intervals of 2 or 3 years offer perhaps the most feasible means of recording the major changes that are taking place and may easily furnish a valuable record for the stockman. Supplemental notes and observation of the kinds and amounts of plants growing on the range and the condition

of the soil surface will furnish specific information as to trend of range condition.

6. Care of the range in good years following drought.—The more or less common practice of building up numbers in the first average year that comes along after a drought is probably one of the major factors in continued range deterioration. Experience on the Santa Rita indicates that proper management of the range will do much to counteract the effects of ordinary drought years. However, even the best management cannot prevent some loss in vigor and density of the forage plants in severe drought years on semidesert ranges. It becomes evident then that the practice of building up numbers in the occasional good years removes the only chance that the range might have to improve. In the drought years the range goes downhill while in the average or better years it barely manages to hold its own—a gradual process of deterioration. Numerous instances on the Santa Rita have shown that holding numbers below the actual capacity in good years and allowing some of the growth to remain on the ground at the close of the year offers one of the most efficient means of range improvement.

7. Plan for range betterment.—A range deteriorated by drought, misuse, or noxious shrub invasion can be brought back to a normal production of forage by constant planning for better management followed by an action program. Don't let a good year stop your plans and action for range improvement.

Additional information on the findings presented in this booklet and other findings obtained from research at the Santa Rita are contained in publications available from the Director, Southwestern Forest and Range Experiment Station, Box 951, Tucson, Arizona.

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